## REMARKS

New dependent claims 34-43 have been added. Claims 1-43 are in the Application.

Claims 1-33 stand rejected as being unpatentable over Volkmann et al. U.S. Patent 4,861,407. Claims 1-33 also stand rejected as being unpatentable over Clarke U.S. Patent 6,176,959. Applicant respectfully traverses this rejection and requests reconsideration.

Claim 1 recites a method of modifying the structure of a workpiece, the method comprising: (1) causing relative movement between a power beam and the workpiece so that a region of the workpiece is melted and the melted material displaced to form a projection at a first location in the region and a hole at a different location in the region; (2) allowing the melted material at least partially to solidify; and thereafter (3) repeating step 1) one or more times, the region corresponding to each repeat intersecting the region of step (1). As described in detail in Applicant's specification, the claimed technique is used to achieve modified built-up structures that are highly useful in the art.

The Volkmann et al. U.S. Patent 4,861,407 discloses a method for bonding a first body to a second body, and for pretreating the first body by placing it in the path of an energy beam. The first body is placed in the path of a beam having a selected energy density for a duration effective to form projections on the metallic substrate of the first body, the projections being formed by evaporation and/or melting of the metallic substrate, substantially all of the projections being less than 20 micrometers in height

(see e.g. col. 2 line 62 through col. 3, line 2, or col. 3, lines 41-48 of the citation). Volkmann et al. indicate, at column 5, that “as long as the energy density for treating the surface is maintained, the relative movement between the laser beam path and the surface to be treated can be as fast as possible,” and that preferably, “each area treated overlaps just a little with the area treated previously so that 100% treatment results” (see col. 5, lines 36-41).

The Clarke U.S. Patent 6,176,959 discloses a method for bonding two surfaces. A laser beam is directed at one or both surfaces to effect “microtexturizing” or “roughening” of the surface(s) by forming depressions and whisker projections, as shown in Figure 1 of Clarke. Thereafter, an adhesive is applied to at least one of the surfaces and the surfaces are then placed against each other for bonding. As indicated at columns 2 and 3 of Clarke, the laser beam is first used to clean and glaze the surface to obtain an oxide layer of thickness of preferably from 200 to 600 Angstroms, followed by roughening to obtain a surface preferably from about 75 to 125 Angstroms thick.

Essentially, the cited prior art discloses the use of power beams to roughen a surface. The background portion of Applicant's specification acknowledges the existence of these types of techniques in the prior art (see e.g. page 2 thereof, and references to “surface texturing,” etc.). In contrast, the present invention involves the formation of larger and more complex structures than are possible with techniques known in the art. Consider the following three aspects of the invention: (1) Firstly, there is provision of effectively a beam path (due to the relative movement) that causes

melting of the material along the path. The physics of this process causes movement of the melted material such that at a first location a depression (hole) is formed and at a second location a hump (projection) is formed; (2) Secondly, the melted material from the previous step is allowed to solidify (at least in part), thus preserving at least some of the depression and hump structure; (3) Thirdly, the power beam is then applied once more, this time along a path which either fully or partly intersects with that of step (1). The structure is thus further modified and the depression and/or hump from step (1) can be further deepened and raised respectively, together with the possible formation of other nearby depressions or humps.

The process of steps (2) and (3) may be repeated numerous times, with either the same or different levels of solidification, and either the same or different intersecting paths in each case. This allows truly macroscopic structures to be generated by the building up of these humps and depressions on top of one another, as described in detail in Applicant's Specification. None of this is possible with the prior art methods in the cited documents.

In the Volkmann et al. '407 Patent, summarized above, although the first body is translated with respect to the power beam, there is no disclosure of the melting <u>during</u> this movement and therefore a path of melted material connecting the "first" and "different" locations is not formed. Instead, in Volkmann, the translation is used to produce individual small (less than 20 micrometer) surface projections at specific spaced apart locations. Thus, the requirement of displacing molten material to form a projection and a hole at different locations is not met. There is also no disclosure in

Volkmann of the at least partial solidification of the material prior to a further later treatment. At best, Volkmann indicates that there may be some overlap (stated by Volkmann to be "just a little overlap") of areas that receive the power beam, but there is no teaching that any previously melted material is remelted. Indeed the technique of Volkmann would regard such remelting as inefficient since all that is desired in Volkmann is to produce myriad projections at numerous spaced apart locations. Whilst the material must solidify, this occurs in Volkmann after the beam has moved on to another location. In Volkmann, the beam does not return and therefore the intersection claimed in step (III) of Applicant's claim 1 is not performed or contemplated. Accordingly, for all of these reasons, the patentable distinction of claim 1 over Volkmann should be evident.

As first summarized above, the Clarke citation is generally similar to the other primary citation and teaches a process to "microtexturize" a surface for the purpose of improved adhesion. The "depressions and whisker projections" of Clarke form a roughened surface stated to be in the range 75 to 125 Angstroms; that is, a maximum of $125 \times 10^{-10}$ meters, an exceedingly small dimension, and several orders of magnitude smaller than the structures described by Applicant. There is no disclosure in Clarke of a melted region containing a projection and a hole at different locations; there is no disclosure of allowing at least partial solidification prior to a further remelting treatment; and there is no disclosure of intersections between any melted region and any subsequently melted region. Accordingly, for all of these reasons, the patentability of Applicant's claim 1 over Clarke should be evident.

Since all claims in the Application depend ultimately from independent claim 1, the foregoing should be completely dispositive of the issue. However, the dependent claims define inventive features which further distinguish over the cited art, and provide additional bases for patentability. Some examples follow.

Dependent claim 5 recites that the path (first defined in claim 3) is at least three beam diameters in length, and dependent claim 6 recites that at least part of the region (first defined in claim 1) is elongate.

Dependent claim 11 recites that each of the regions of step 3) coincides substantially with the region of step 1). This method provides the types of structures shown, for example in Figures 2-6 of Applicant's Specification.

Dependent claim 12 recites forming one or more groups of regions, each group intersecting the region of step 1), dependent claim 13 recites that the holes of each group are substantially co-incident with the hole of the region of step 1) (e.g. Applicant's Figure 10), and dependent claim 14 recites that projections of each group are substantially coincident with the projection of the region of step 1) (e.g. Applicant's Figure 11). Dependent claim 15 recites that the groups of regions are arranged in a regular array.

Dependent claim 19 recites that the intersecting regions are arranged so as to form projections which overhang the workpiece surface, and dependent claim 20 recites that two or more overhanging projections are joined so as to form one or more loops above the workpiece surface.

Dependent claim 21 recites that the power beam energy density is reduced

during step 3) with respect to the one or more previous movements of the power beam, so as to smooth the edges of the projection and/or hole formed.

New dependent claim 36 recites that the material is displaced by each repetition of step 1) such that either or each of the projection or hole are increased in size in comparison with their respective size following the first application of step 1), and new dependent claim 37 recites that repeated intersection of the regions causes one or each of the projection or hole to increase in size.

New dependent claim 38 recites that material is repeatedly displaced so as to form a different geometry or structure as a result of each repeat according to step 3) due to the at least partial solidification between each repeat according to step 2).

New dependent claims 41 and 42 recite that step 3) comprises repeating step 1) numerous times, and new dependent claim 42 also recites that material is repeatedly displaced so as to form a different geometry or structure as a result of each repeat according to step 3) due to the at least partial solidification between each repeat according to step 2).

With regard to the foregoing examples, as well as other dependent claims, the cited prior art contains no teachings that would anticipate or render obvious the steps and features set forth. In the event that Examiner intends to enter any continuing or new rejection of the dependent claims, Applicant respectfully requests that the Examiner specifically identify the teachings in the citations that purportedly anticipate or render obvious the claimed invention.

In summary, Applicant has demonstrated the novelty and unobviousness of the

claimed method for modifying the structure of a workpiece. The Office Action acknowledges that the two applied citations (Volkmann et al. '407 and Clarke) "do not describe timing steps in order to allow the melted material to at least partially solidify between formation of subsequent projections" and that the "particular timing would have been obvious." However, Applicant has demonstrated that the citations do not disclose the claimed steps, and attributing "timing" to the citations (particularly in the absence of any rationale in the citations for such "timing") would still not overcome their deficiencies in teaching or suggesting steps of the claimed invention, as has been delineated herein. As shown in detail above, both citations are directed to roughening surfaces, and neither of them is directed to building of structure with holes and projections, involving repetition of melting in the manner claimed. Indeed, Clark has no teaching whatsoever of any return or remelting. In Volkmann et al. '407, there is also no such teaching. The reference in Volkmann et al. to "just a little overlap" is stated to be for the purpose of "100 percent treatment," and is certainly not for the purpose of any repetitive structure building. Any doubt on this point can be dispelled by referring to Example 28 and Figure 9 of Volkmann, which show that Volkmann wishes to avoid projections exceeding 20 micrometers to prevent the purportedly inferior performance resulting from projections in the 20 to 45 micrometer range as in a prior Japanese Patent Application (and illustrated in Volkmann's Figure 9). Thus, the Volkmann et al. citation actually teaches away from using the power beam to repetitively build structure, much less in the way defined by Applicant's claimed method.

In view of the foregoing it is believed that all claims of this application are now in

condition for allowance, and such favorable action is respectfully solicited. In the event there are any remaining issues, however, it is asked that the Examiner kindly telephone the undersigned counsel collect so that they can be resolved.

Respectfully submitted,

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